

## Onboard Networking

More and more applications and hardware on boats can take advantage of real-time internet access. Having a live connection underway provides many advantages that will translate into increased success and safety.

### Why bother?

#### **Live data**

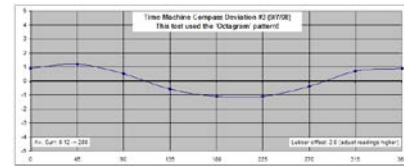
Images and data from the web can be displayed in real-time. Examples include many kinds of weather data including GRIB files, weather buoy readouts and radar weather displays.

When an internet connection is available, Vysion can display these images without any human intervention or the need for an onboard computer.



#### **Calibration**

Good calibration leads to more wins. However, it is a pain to do, and absorbs valuable resources. DeWiggler provides that extra crew member to help with this essential task. With a live internet connection, calibration can be accomplished remotely.



#### **Troubleshooting**

With a live internet connection, your instrument system can be accessed from off the boat. Ockam provides the Tshooter expert application to allow real-time analysis.

### I already have an internet connection

Most people assume a cell dongle attached to their laptop provides all the internet connection they need. However, the only thing connected is the laptop; none of the other hardware on the boat has access. To allow all devices on the boat (including Vysion and PDAs) access, the internet connection must be made part of the boat's local network.

This paper describes how to accomplish this wider and more useful connection.

### Ockam's agenda vis-à-vis networks on boats

Many components of the Ockam system are designed to use an internet connection when available. To do these things, your boat network should be able to connect to the internet at least once in a while.

### **What's involved?**

A cell router and modem. This provides total internet connectivity wherever the cell network can be received. You should purchase it through your cell phone provider to ensure compatibility with your cell phone account.

Cell routers go for about \$250.

<http://www.sierrawireless.com/product/airlink/RavenXE.aspx>  
<http://www.evdoinfo.com/content/view/2259/63/>  
<http://www.ericssonw35.com/>



A cell antenna provides additional range. There are both wireless and wired types, the wired being more efficient and less prone to feedback.

Antennas go for about \$100.



You will probably want to have your network set up by a knowledgeable dealer, especially if you want the increased range offered by a cell antenna.

## Technical Information

### Ethernet

Ethernet is the standard local network. It defines protocols (languages) and the physical medium (cables). It has many things going for it: it is cheap, ubiquitous, fast and flexible. It also has a few bad attributes.

1. Standard Ethernet cable and connectors are definitely not marine friendly.
2. You can't daisy-chain the cable. If you want to go more than one place, you need a hub.
3. Under the surface, there is a lot of technical stuff that has to be set correctly.

### Cabling

Ethernet cabling has 4 twisted-pair wires with 'RJ-45' connectors at each end. Normal cables are wired in such a way that if you hold both ends as shown, the color order is the same. Cables wired opposite are crossover cables which are almost never useful. In fact they are dangerous when mixed in with normal cables.



All the Cat-5 cable you can get your hands on at retail has solid conductors. This type of cable will fail on shipboard due to vibration. You really should go on the internet and find stranded Cat-5 cable and the special RJ-45 connectors made for it.

**Use stranded Cat-5 cable.**

### Hubs

Hubs (an out-of-date term) is hardware that takes in 1 cable and provides multiple sockets to originate other cables, like a power strip does for 110v power. Nowadays, they have been replaced by switches, which are hubs with a brain. Nevertheless, we will continue to use the word hub for the 'power strip' idea to distinguish it from a router, which is a switch with an agenda.

**Anything going into a hub comes out all the other cables unchanged.**

Some hubs have one of their sockets marked 'Link'. And sometimes, the link socket has a switch to change the sex of the connection. This is where the originator wire goes, and the rest of the sockets are clones. Others hubs are smart enough to figure it out by themselves. In all cases, the lights should light up when you plug in a wire that is attached to another piece of hardware.

### Routers

Routers are different from hubs (switches). There is an upstream side and a downstream side. The downstream side (usually several sockets) works like a hub; what goes in, comes out on the other downstream sockets (usually). In the case of wireless routers, the downstream side also includes a WiFi radio.

The upstream side (usually only 1 socket) is not part of the downstream network. Anything going on there will usually NOT be passed downstream (unless the router decides the traffic is for one of them). The upstream side is intended to be connected to the Internet and should not be plugged into any other router or switch or hub of the installation.

**There should be ONE and only ONE router on your local network.**

## IP addresses and DHCP

An IP address is the 'PO box' that each machine ('host') must have in order to communicate over Ethernet. You have probably seen them; they look like this: 192.168.1.102.

DHCP stands for Dynamic Host Configuration Protocol. It assigns IP addresses to the computers (hosts) attached to the network. There are DHCP servers (supply addresses) and DHCP clients (receive addresses). Computers are clients, and routers are servers.

**There should be ONE and only ONE DHCP Server on a network.  
Routers include a DHCP server to assign IP addresses to downstream hosts.**

## Topology and Subnets

Topology is the layout of the network. It is more than the physical arrangement, because there can be more than one logical network (subnet) existing in the cables of a single installation (intentionally or otherwise). Two cables going into the same box may not be able to communicate with each other because they are on different subnets. Same cables, same box, different universe. Most problems in network setup are caused by issues with subnets.

IP addresses have two sections: the subnet part and the host part. The parts are defined by the subnet mask. In this case the subnet mask allows for a maximum of about 250 hosts.

IP address	192	168	1	102
Subnet mask	255	255	255	0
Subnet	192	168	1	
Host				102

In this example, all hosts on subnet 192.168.1 can communicate directly with each other. In order to go "outside", a router must be used to connect the subnet with the world outside. And there is a problem. IP addresses beginning with 192.168 cannot be routed. In other words, you can't ask a router on subnet 192.168.1 to connect you to host 192.168.10.4.

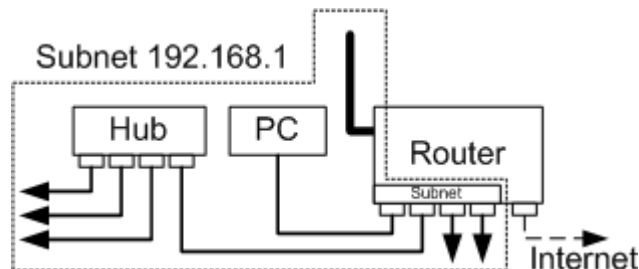
**EVERY host (computer) in a network should be on the SAME SUBNET.**

## Why you should use DHCP and not static addressing

Originally all IP addresses were assigned manually. But, as you can see, it is easy to make a mistake, preventing a host from communicating. There are also other things that have to be set correctly (subnet mask, default gateway, DNS suffix and servers, etc.) for a host to be able to go outside the router and contact the greater world.

If you need to have an IP address that doesn't change, it is best to tell the DHCP server (the router) to always assign a specific address to a specific box. And your assignment **MUST** use the same subnet that the other hosts and the router are using. Then there will be 'static IP' functionality without trashing all the other convenient stuff that DHCP provides.

## Typical network hookup



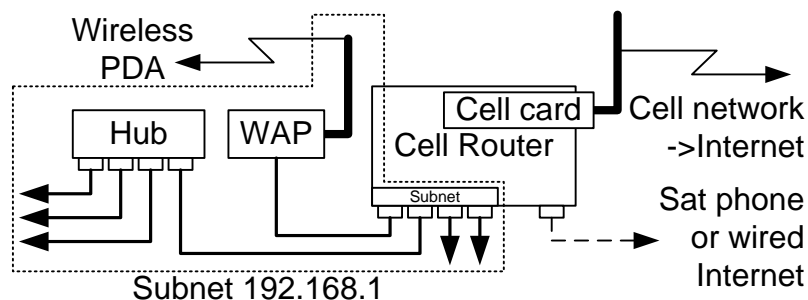
### Adding a (second) WiFi radio

You may need to add a WiFi radio to your local network to cover the above-deck area because the first radio is shielded by the hull, or your router does not have WiFi built in. Do not use a WiFi router for this job for the reasons explained above. Instead, you should use a wireless access point (WAP). These devices do not have router functionality and therefore do not create a second subnet.

### Connecting to the Internet via the cell network

The old way to connect to the cell network was to plug a USB cell modem into your PC. The problem then is that only that PC has a web connection. The modern way is to use a cell router designed to connect to a local network. These units accept the cell modem that you used to plug into your PC. When this device is used, all hosts on the network can access the Internet, including wirelessly.

Several cell routers are listed in the resources section below.



### Connecting via a sat phone

Satellite phones usually provide a WAN connection, with one or more sockets. These devices are routers, so you could theoretically use them as the boat's router. The problem is that the sat-phone has to be powered up to provide the router service. A better way is to use a multi-WAN router (such as the Peplink below) which accepts two or more WAN connections. One goes to the cell router (for use when the sat phone is off) and the other to the sat-phone. Some cell routers also have a WAN connector, allowing the sat phone to be used when out of cell range.

### Connecting via a WiFi hotspot

You have probably used the boat's PC to connect to a hot spot, say at your marina. Unless you do something about it, the connection will only happen if the PC has a WiFi radio. The radio on a WiFi router will not connect to an internet hot spot; it is the 'hot spot' for your network. To provide full internet connectivity, you need a device designed for the job, e.g. the Syrens long-range WiFi amplifier (see below). These devices have powerful radios to make a connection over a much greater distance than your PC radio can muster.

### Things to watch out for

- Above all, be sure you don't have multiple subnets.
- Some home networking hubs are actually routers. If you use one of these, your boat will have two subnets who can't talk to each other. Be sure to read the box carefully before buying and keep your receipt.

- You can disable DHCP on some routers, turning them into hubs. However, they usually revert to being a router just when you thought everything was working.

### **Troubleshooting the network**

1. Be sure all Ethernet connections have lights indicating activity.
2. Log onto the router and confirm that all your boxes have been assigned an IP address.
3. Connect your PC to the network. Run a command prompt and type IPCONFIG
 

```
IPCONFIG
IP Address . . . . 192.168.1.104
Subnet Mask . . . . 255.255.255.0
Default Gateway . . 192.168.1.1
```

This confirms the subnet the machine is on. If you don't see one of your boxes, connect the PC to the same RJ-45 the missing box was using and repeat the IPCONFIG test to check that you can reach the same subnet.
4. A useful tool is a 'lan scanner' which finds all the hosts on your subnet (see Lan scanner below). This tool should part of your memory stick inventory.
5. Try 'pinging' your boxes, and, if internet is live, ping somewhere in the wide world. Run a command prompt and type
 

```
Ping Vysion12345 (or whatever serial number your Vysion is)
Ping Ockam.com
```

You should get a response.
6. Use the UDPmon tool (see below) to check the Ockam UDP broadcast.

### **Resources**

Long-range hot spot connections (WiFi)

[http://www.radio-at-sea.com/Products\\_main.htm](http://www.radio-at-sea.com/Products_main.htm)

Multi-WAN routers

<http://www.peplink.com>

Cell modem/Routers

<http://www.sierrawireless.com/product/airlink/RavenXE.aspx>  
<http://www.evdoinfo.com/content/view/2259/63/>  
<http://www.ericssonw35.com/>

Lan scanner

<http://www.tucows.com/preview/267216>

Ockam documents and tools for Ethernet & Internet

<a href="http://www.ockam.com/docs/UDPbroadcast.pdf">http://www.ockam.com/docs/UDPbroadcast.pdf</a>	Instrument data on Ethernet
<a href="http://www.ockam.com/docs/UDPmonInstall.exe">http://www.ockam.com/docs/UDPmonInstall.exe</a>	UDP monitor tool
<a href="http://www.ockam.com/LANbridge/index.html">http://www.ockam.com/LANbridge/index.html</a>	UDP without an onboard PC
<a href="http://www.ockam.com/docs/TwoBoatTestingWithEye.pdf">http://www.ockam.com/docs/TwoBoatTestingWithEye.pdf</a>	